

REPORT DOCUMENTATION PAGE			Form Approved OMB NO. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comment regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE 1996	3. REPORT TYPE AND DATES COVERED Technical		
4. TITLE AND SUBTITLE Visualization in Scientific Computing		5. FUNDING NUMBERS DAAH04-95-1-0250		
6. AUTHOR(S) Padma Reddy, M. Balaram, Chenjerai Bones, and Y.B. Reddy		8. PERFORMING ORGANIZATION REPORT NUMBER		
7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(ES) Grambling State University Department of Math and Computer Science Grambling, LA 71245		10. SPONSORING / MONITORING AGENCY REPORT NUMBER ARO 34157. 40-MA-152		
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Research Office P.O. Box 12211 Research Triangle Park, NC 27709-2211		11. SUPPLEMENTARY NOTES The views, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other documentation.		
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited.		12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words) Visualization is often referred to as scientific visualization or visualization in scientific computing. Visualization helps us extract useful information from complex or often voluminous data sets through the use of interactive graphics and imaging. The theory of visualization uses foundations of the following fields and unifying them: Computer Graphics, Image Processing, Computer Vision, Computer Aided Design, Signal Processing, User Interface Studies, Cognitive Science, and Computational Geometry. The visualization technology was started with excitement and enthusiasm and gradually changed the scientific field for the past two decades. In this presentation, we briefly review the following topics: Visualization - Some important points to note Visualization - Microarchitecture workbench Visualization - Medical field Visualization - Computer Generated Forces (CGF)				
14. SUBJECT TERMS visualization, image processing		15. NUMBER OF PAGES 11		
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED		18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED		16. PRICE CODE
19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED		20. LIMITATION OF ABSTRACT UL		

NSN 7540-01-280-5500

Enclosure 1

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18

19970210 086

Visualization in Scientific Computing

Padma Reddy, M. Balaram, Chenjerai Bones, Y.B.Reddy
Grambling State University, Grambling LA 71245.

Visualization often referred to as scientific visualization or visualization in scientific computing. Visualization helps us extract useful information from complex or often voluminous data sets through the use of interactive graphics and imaging. The theory of visualization uses foundations of the following fields and unifying them:

Computer Graphics, Image Processing, Computer Vision, Computer Aided Design, Signal Processing, User Interface Studies, Cognitive Science, and Computational Geometry.

The visualization technology was started with excitement and enthusiasm and gradually changed the scientific field for past two decades. In this presentation we discuss brief review of the following topics:

- Visualisation - Some important points to note
- Visualization - Microarchitecture workbench
- Visualization - Medical field
- Visualization - Computer Generated Forces (CGF)

Note: This research is supported by Advanced Distributed Simulation Research Consortium

Visualization in Scientific Computing

Padma Reddy

Chenjerai Bones

Advisors: M. Balaram and Y.B.Reddy

Grambling State University

Department of Mathematics and Computer Science

Grambling LA 71245.

Visualization in Scientific Computing

What is Scientific Visualization

Scientific Visualization aims to devise algorithms and methods that transform massive scientific data sets into pictures and graphic representations that facilitate comprehension and interpretation.

The theory of visualization uses foundations of the following fields and unifying them.

- Computer Graphics
- Image Processing
- Computer Vision
- Computer Aided Design
- Signal Processing
- User Interface Studies
- Cognitive Science
- Computational Geometry

The visualization technology was started with excitement and enthusiasm and gradually changed the scientific field for past two decades.

Where would visualization be necessary?

- Defense
 - Computer Generated Forces
 - Advanced Distributed Simulation Applications
- Medical
 - Medical Imaging
 - Molecular Graphics
- Engineering
 - Computer Aided Design
 - Computer Architecture
- Computational Fluid Dynamics
- Computer Graphics Applications

Equipment:

- Super Computers
- Satellites
- Medical scanners
- Microscopes
- Radio telescopes
- geographical sensors
- Geometric and Computational models

We use many techniques for visual representations.

A separate journal is started on Visualization in 1995. The name of the journal is:
IEEE Transactions on Visualization and Computer Graphics (TVCG)

Single-Chip microarchitecture used for Visualization

DEC Alpha AXP 21164

Single chip, 64-bit superscalar processor

Two integer, two floating-point pipelined functional units
(can issue two instructions at each machine cycle)

9M transistors with 300 MHZ clock time
(targeted 10M transistors in 1996)

Power-PC 620 Microprocessor

can issue upto four instructions in every machine cycle

Recent Intel Pentium Pro-Microprocessor

5.5M transistors

200 MHZ clock time

Deep pipelining (Could not get number of pipelining instructions)

Performance Simulators:

Explore machine features and quickly assess the impact of these on overall processor performance

Performance Simulators have three weaknesses.

- They lack retargetability, visualization support, and interactive control
- The prospective simulators must contain these features.

VMW Overview

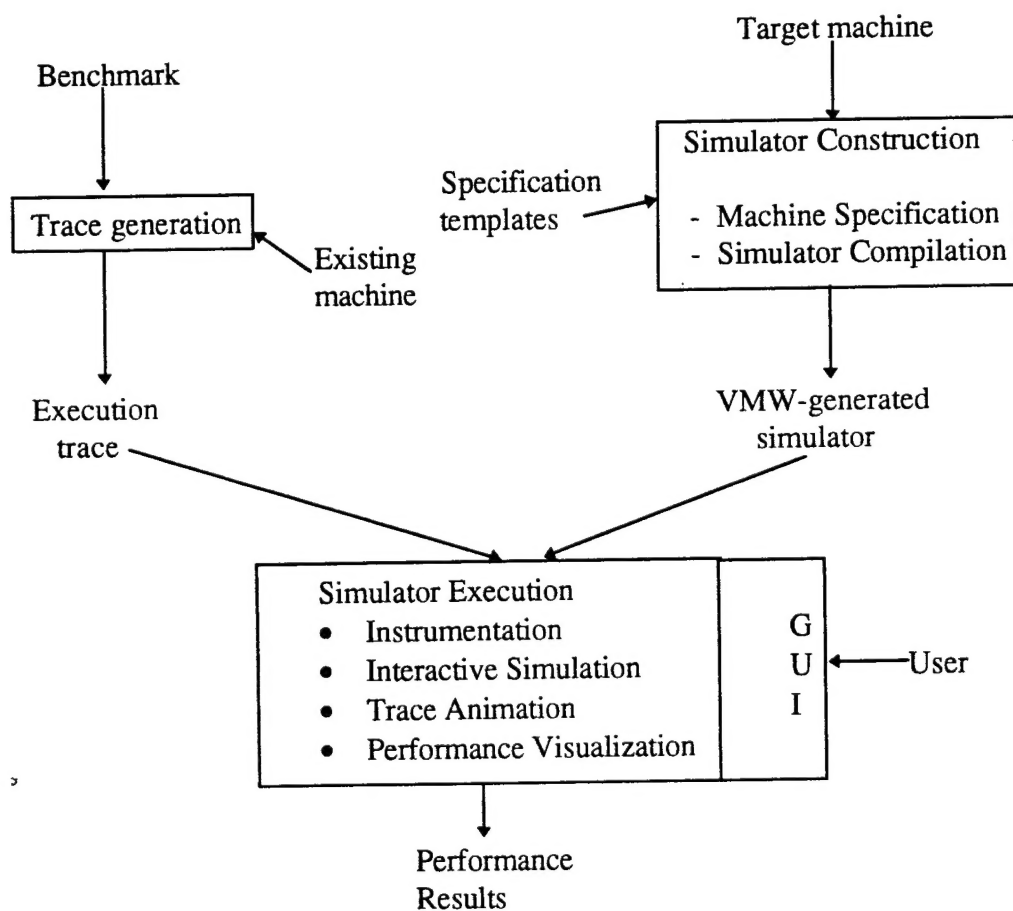
VMW provides all necessary instructions to generate target machine

VMW integrates the machine specifications and infrastructure software to generate a customized performance

The resultant simulator generates the visualization capabilities

The three main functions in VMW are:

- Trace generation (execution trace)
- Simulator Constructon (VMW generates Simulator)
- Simulator Execution



Simulator Construction

The Simulator task involves the actual running of the VMW-generated simulator

This task consists of three sub-tasks:

Instrumentation:-

Lets the user specify what information is to be collected during simulation and how the data is to be presented

Simulation:-

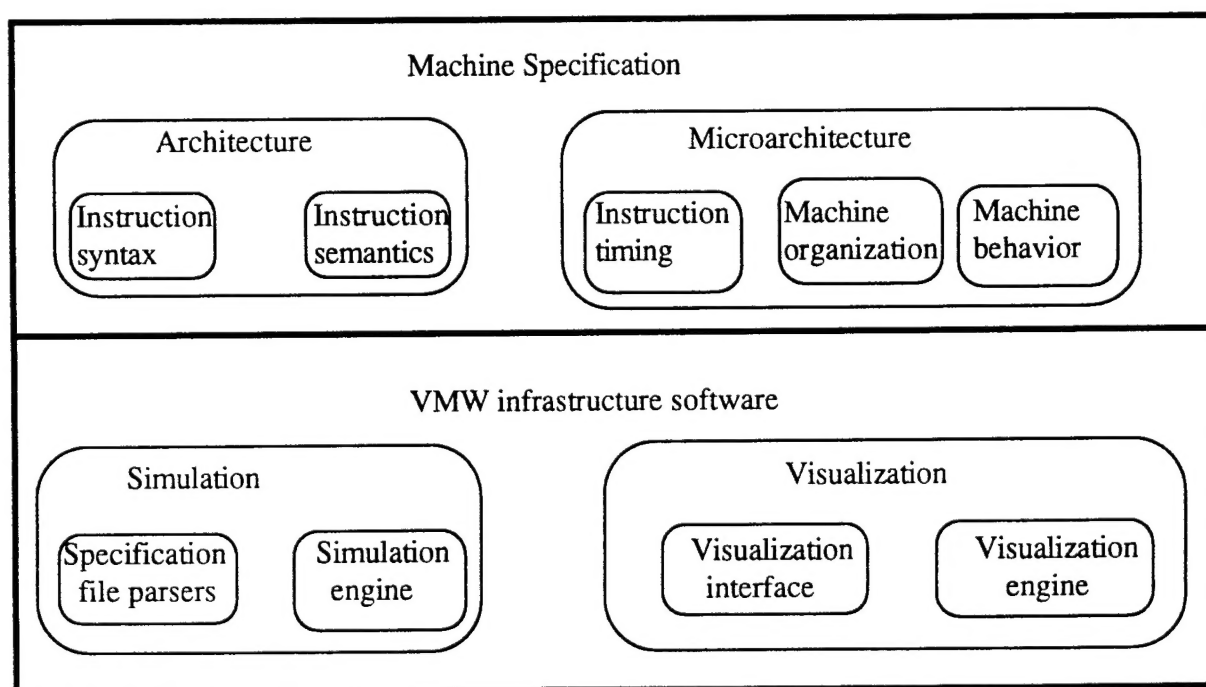
Occurs when simulator is involved by the user via a graphical User Interface (GUI). -User has interactive control of simulation process.

Visualization:-

Displays graphically the performance data selected in the instrumentation subtask.

Visual effects can be observed on the fly.

The effects are Animation and Performance visualization



Key components of a VMW-generated simulator

Machine Specifications of three processors:

Specification file	File Size		
	Number of templates or lines of code		
	AXP 21064	PowerPC 601	PowerPC 620
Instruction syntax (templates)	487	383	383
Instruction Syntax (templates)	37	205	205
Instruction Timing (templates)	24	112	113
Machine Organization (templates)	39	51	75
Machine Behavior (C++)	668	1,086	3,702

Machine behavior specification can be changed by modifying few lines of C++ code.

All the three machines same infrastructure software provided by VMW for simulation and Visualization support

VMW infrastructure software has 15,000 lines of code in C++

The above table gives the size of the machine specification after execution of VMW

DO NOT COMPARE

Current Status

VMW was demonstrated at the following R & D

- Motorola
- IBM
- Intel
- Texas Instruments
- Hitachi
- Philips Research
- CMU - Used as Preliminary Design tool in the Super Scalar Processor Design

First Version Tested and Demonstrated

VMW is a Useful tool in academic research as well as Industry Designers
(available in 1996)

Visualization in medical field

The computer applications in surgery can deliver:

- Efficient surgery, with reduced operating room expense;
- Less morbidity;
- Procedures with fewer complications;
- Increased surgical precision to reduce possible damage to adjacent tissue;
- Improved patient outcomes (faster rehabilitation at lower cost, with less interruption); and
- An opportunity to perform new, or previously impossible, minimally invasive procedures.

Computer-assisted surgery (CAS) has been implemented in the following areas.

- **Neurosurgery**
- **Surgical planning**
- **Anatomic models**
- **Custom prostheses**
- **Robotic assistance**
- **Image-guided surgery**
- **Custom anatomic atlases**
- **Virtual reality**

Visualization - Computer Generated Forces (CGF)

Computer Generated Forces (CGF) development was first started under the ARPA SIMNET project in 1986. The introduction of DIS helped more in implementing the CGF through ModSAF. ModSAF has a software repository, and can be added and modified the software modules. It is the most widely used CGF system, supporting many projects including WISSARD, A2ATD, STOW, Prairie Warrior, CCTT, JPSD, and Kernel Blitz.

The progress of CGF will be made by developing:

- The maps and reference points (shared abstractions),
- Navigational instruments (evaluation standards and techniques), and
- Trails (reusable modules and data)

Some of the characteristics of the simulated system are:

- A single set of requirements, although they can come from different programs or applications and evolve over time;
- A single architecture for linking the system components together, although the components may have different internal architectures;
- Non-overlapping components that maximize productivity by using a single model for each phenomenon to be simulated;
- A single development team which may be composed of multiple contractors;
- A single set of milestones and schedules.

The important features of a CGF repository should include:

- Multiple model versions
- Multiple Architectures
- Multiple time management Approaches
- Technology Utilities
- Data
- Project Scheduling Decoupling

The technical challenges are:

- Finding modules - using standard classification schemes
- Understanding Module Implementations:- Documentation, environmental stimuli, and functionality.
- Incorporating the models:- Standardize using appropriate semantics (e.g., Math subroutines)
- Evaluation of modules: re-engineer the existing module and implement
- Building Systems: use a reference system and extract appropriate module and use in new proposed system
- Update rate: The repository must have the latest software